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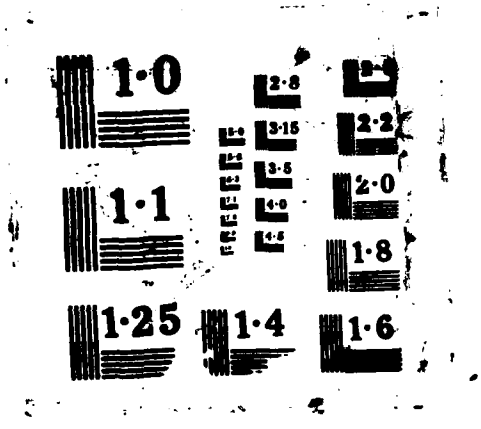
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by

Wang Suifu

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NEW BREAKTHROUGH IN CHINESE INTEGRATED CIRCUITS - SUCCESSFUL DEVELOPMENT OF HIGH-SPEED CMOS CIRCUITS

Wang Suifu

In the field of high-speed logic circuits, the new bipolar type integrated circuits have held a prominent position for some time now. Unfortunately, a fatal flaw of the bipolar type circuit is that power dissipation is high and, consequently, they are greatly limited in application. Since CMOS circuits have the distinctive advantages of low power dissipation and good anti-interference properties they are looked upon with favor. The shortcoming of the CMOS circuit is that its speed is rather low. In the early 80's, integrated circuits entered the VLSI era and were successfully developed one after another using micro-processing technology as the core, thus improving the CMOS circuits so that they entered the ranks of the high-speed logic circuits. Since 1981 every inductrially developed nation has successfully developed high-speed CMOS circuits (54/74HC series CMOS circuits) having speeds which can compare rather favorable with (and base pin arrangements which are interchangeable with) the low power dissipation TTL circuits. The speed of these kinds of circuits has been raised to tens of times that of ordinary CMOS circuits, but the advantages which are inherent in CMOS circuits, low power dissipation, good anti-interference properties, and high input impedance, have still been maintained. As a result all the countries are competing with each other to develop these circuits as quickly as possible. Among those, several famous U. S. companies such as NSC and Motorola have already developed more than 300 varieties. Some people predict that the appearance of high-speed CMOS circuits will result in CMOS technology replacing PMOS

and NMOS technology in all areas because of speeds getting faster and faster. The sales volume of high-speed CMOS circuits was only U.S. $16,000,000 in 1982, but will reach U.S. $280,000,000 in 1987. At present, the 54/74HC series circuits are already widely used in such areas as high-speed electronic computers, electronic communications, industrial automated controls, intelligent instruments, aviation and medical instruments and domestic appliances. In some important anti-interference and irradiation-resistant shock-resistant parts nearly all the "leading roles" are played by high-speed CMOS circuits.

After making developments in such micro-machining techniques as ion implantation and dry method etching, the Shanghai Metallurgical Institute of the Chinese Academy of Sciences, in cooperation with Shanghai Radio Factory 14, undertook development of 74HC series high-speed CMOS circuits in order to fill a domestic gap and to satisfy urgent needs in various fields. The industry has a great need for development of this circuit. Conductor width must not be greater than 3 μm and new technologies with a high degree of difficulty must be employed such as complete ion implantation, positive film photo etching, dry method photo-etching, etc. Due to the fact that over the last several years the metallurgical institute has accumulated a considerable amount in the area of fine machining technology and in research in ion implantation low temperature technology, and have increased their active cooperative joint efforts with Shanghai Radio Factory 14, quite satisfying results have been obtained. In the process of their cooperation, the Shanghai Metallurgical Institute is responsible for chip dissection, domain design, engineering research and prototype development. Shanghai Radio Factory 14 is responsible for test manufacturing and expansion of product types as well selection of technicians to be trained at the Shanghai Metallurgical Institute. Under the cooperative efforts of both sides, the pace of development has been fairly rapid. Since chip dissection, domain design and engineering research first began in November 1983, current testing had been conducted and process circulation achieved by January 1984. May 1984 saw the partial test introduction of 74HC00 and 74HC02 circuit boards and by the end of June four prototypes had been completed, the 74HC00 (two-input device "AND-NOT" gate), the 74HC02 (two-input device "OR-NOT" gate), the 74HC74 (double D trigger), the

74HC164 (8-bit series input/parallel output shift register), achieved a successful introduction and carried batch processing on these four product types. Shanghai Radio Factory 14 also set up a high-speed silicone gate CMOS production line and achieved circulation of the entire line. On the eve of the 35th anniversary of the founding of our nation, they have also developed and manufactured eleven sample electrical circuits such as the 74HC244, and as a result of rigorous examination by the evaluation committee of the Shanghai-Shi science committee organization, a technologically stable and reliable chip was certified and developed for the 74HC series 3mm silicone gate high-speed CMOS circuit. Initial acceptability rate averaged about 40%. The various dynamic and static parameters have already reached the index of similar type products produced overseas and in some cases exceeded them. Eleven new products were also developed in 1985.

Both the research institute and the factory have worked hand in hand to tackle problems, bringing into full play the advantages of each, and in less than one year developed more than 10 high-speed CMOS circuits, not onlt to satisfy the demand of the domestic market, but also to be able to jump into and compete in the international market. The factory and the institute together have accelerated the achievements in scientific research and have changed the pace of production forces.

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